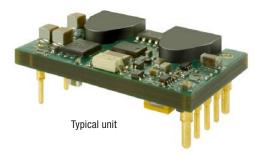


ULS 60-Watt Series

Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters

FEATURES

- Small footprint DC/DC converter, ideal for high current applications
- Tiny 0.9" x 1.3" x 0.40" open frame package
- Industry standard DOSA "brick" format and pinout with surface mount option
- 36-75 Volts DC input range
- 2250 Volt Basic input/output isolation (48V models)
- Up to 66 Watts total output power with overtemperature shutdown
- High efficiency synchronous rectifier forward topology
- Stable no-load operation with no required external components
- Operating temperature range -40 to +85°C with derating
- Certified to UL 60950-1, CSA-C22.2 No. 234, safety approvals, 2nd Edition, IEC 62368
- Extensive self-protection shut down features



PRODUCT OVERVIEW

The world of "brick" DC/DC converters has seen a steady size reduction. The ULS series makes another dramatic size shrink down to a "sixteenthbrick" width (0.9 inches) while still retaining up to 66 Watt output and full 2250 Volt DC isolation. The PC-board mount converter family accepts 36 to 75 Volts DC inputs and delivers fixed outputs regulated to within $\pm 0.2\%$. The ULS converters are ideal for datacom and telecom applications, cell phone towers, data centers, server farms and network repeaters.

ULS outputs may be trimmed within $\pm 10\%$ of nominal output while delivering fast settling to current step loads and no adverse effects from higher capacitive loads. Excellent ripple and noise specifications assure compatibility to circuits using CPU's, ASIC's, programmable logic and FPGA's. No minimum load is required. For systems requiring controlled startup/shutdown, an external remote On/Off control may use a switch, transistor or digital logic. Remote Sense inputs compensate for resistive line drops at high currents.

Many self-protection features on the ULS series avoid both converter and external circuit hazards. These include input undervoltage lockout and overtemperature shutdown. The outputs current limit using the "hiccup" autorestart technique and the outputs may be short-circuited indefinitely. Additional features include output overvoltage and reverse conduction elimination.

The synchronous rectifier forward topology yields high efficiency for minimal heat buildup and "no fan" operation.

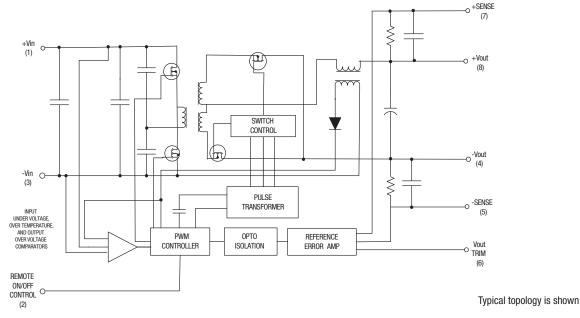


Figure 1. Simplified Block Diagram





ULS 60-Watt Series

Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters

PERFORMANCE SPECI	FICATION	IS SUMMAR	RY AND O	RDERING (GUIDE ①									
Output			Input			Efficiency		C76						
Root Model ①	Vout	Іоит	Power	R/N (mV	pk-pk) ②	Regulation	n (max.) ④	VIN Nom.	Range	lin, no load	lın, full	EIIIC	lency	Package
	(V)	(A, max.)	(W)	Тур.	Max.	Line	Load	(V)	(V)	(mA)	load (A)	Min.	Тур.	Case (inches)
ULS-3.3/20-D48N-C	3.3	20	66	70	120	±0.1%	±0.2%	48	36-75	20	1.53	89%	90%	0.9x1.3x0.40
ULS-5/12-D48N-C	5	12	60	50	80	±0.125%	±0.25%	48	36-75	40	1.39	88%	90%	0.9x1.3x0.40
ULS-12/5-D48N-C	12	5	60	80	120	±0.125%	±0.25%	48	36-75	50	1.37	88%	91%	0.9x1.3x0.40

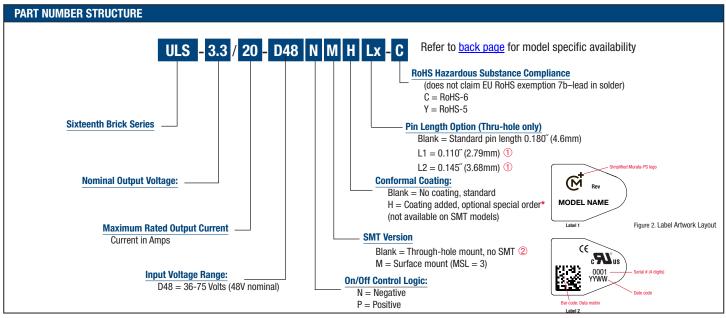
① Please refer to the Part Number Structure when ordering.

^② These specifications are preliminary. Contact Murata Power Solutions for availability.

③ All specifications are at nominal line voltage and full load, +25°C unless otherwise noted. See detailed specifications. Output capacitors are 1 µF ceramic multilayer in parallel with 10 µF electrolytic.

I/O caps are necessary for our test equipment and may not be needed for your application.

④ Regulation specifications describe output voltage deviations from a nominal/midpoint value to either extreme (50% load step).



- ① Special quantity order is required; samples available with standard pin length only.
- ② SMT (M) versions not available in sample quantities.
- ③ Some model number combinations may not be available. See website or contact your local Murata sales representative.

Product Label

As shown in figure 2, because of the small size of these products, t he product labels contain a simplified Murata-PS logo and a character-reduced code to indicate the model number and manufacturing date code. Not all items on the label are always used. Please note that the label differs from the product photograph.

ULS 60-Watt Series

Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters

FUNCTIONAL SPECIFICATIONS, ULS-3.3/20-D48

ABSOLUTE MAXIMUM RATINGS	Conditions ①	Minimum	Typical/Nominal	Maximum	Units
nput Voltage, Continuous	Full power operation			80	Vdc
Input Voltage Transient	Operating or non-operating, tested:			100	Vdo
Input Voltage, Transient	100 mS max. duration			100	Vdc
Isolation Voltage	Input to output			2250	Vdc
Input Reverse Polarity	None, install external fuse		None		Vdc
On/Off Remote Control	Power on, referred to -Vin	0		15	Vdc
Output Power		0		66.66	W
Output Current	Current-limited, no damage, short-circuit protected	0		20	А
Storage Temperature Range	Vin = Zero (no power)	-55		125	°C
	ure of devices to greater than any of these conditio	ons may adversely at	fect long-term reliability. P	roper operation unde	r conditions oth
	al Specifications Table is not implied or recommend				
INPUT					
Operating voltage range		36	48	75	Vdc
Recommended External Fuse	Fast blow			4	A
Start-up threshold, turn on	Rising input voltage	33.5	34.5	35.5	Vdc
Undervoltage shutdown, turn off @	Falling input voltage	31.5	32.5	33.5	Vdc
Overvoltage protection		01.0	NA	00.0	Vdc
Reverse Polarity Protection	None. install external fuse		NA		Vdc
Internal Filter Type	וווסנמוו לגנפווומו ועשפ				Vuc
			Capacitive		
Input current Full Load Conditions	Vin _ nominal		1.50	1 50	Λ
Low Line	Vin = nominal		1.53	<u>1.56</u> 2.15	A
	Vin = minimum			2.15	
Inrush Transient			0.05	200	A2-Sec.
Output in Short Circuit			150	300	mA
No Load input current	lout = minimum, unit=0N		30	100	mA
Shut-Down Mode Input Current			5	15	mA
Reflected (back) ripple current @	no filtering		150	210	mAp-p
Reflected (back) ripple current @	Measured at input with specified filter		20	30	mAp-p
GENERAL and SAFETY					
Efficiency	Vin=48V, full load	89	90		%
	Vin=Min	86	88		%
Isolation	1		- <u>,</u>		
Isolation Voltage, input to output				2250	Vdc
Insulation Safety Rating			basic		
Isolation Resistance			100		MΩ
Isolation Capacitance					
			1000		pF
Safety (meets the following requirements)	UL-60950-1, CSA-C22.2 No.60950-1, IEC60950-1, 2nd Edition, IEC62368		1000 Yes		pF
Safety (meets the following requirements) Calculated MTBF	IEC60950-1, 2nd Edition, IEC62368 Per MIL-HDBK-217F, ground benign, Tambient=+40°C				
Calculated MTBF	IEC60950-1, 2nd Edition, IEC62368 Per MIL-HDBK-217F, ground benign,		Yes		Hours x 10 ³
Calculated MTBF	IEC60950-1, 2nd Edition, IEC62368 Per MIL-HDBK-217F, ground benign, Tambient=+40°C Per Telcordia SR332, issue 1, class 3, ground		Yes TBD		Hours x 10 ³
Calculated MTBF Calculated MTBF @ DYNAMIC CHARACTERISTICS	IEC60950-1, 2nd Edition, IEC62368 Per MIL-HDBK-217F, ground benign, Tambient=+40°C Per Telcordia SR332, issue 1, class 3, ground	480	Yes TBD	520	Hours x 10 ³
Calculated MTBF Calculated MTBF ④ DYNAMIC CHARACTERISTICS Fixed Switching Frequency [®]	IEC60950-1, 2nd Edition, IEC62368 Per MIL-HDBK-217F, ground benign, Tambient=+40°C Per Telcordia SR332, issue 1, class 3, ground	480	Yes TBD 3200	<u>520</u> 15	Hours x 10 ³ Hours x 10 ³
Calculated MTBF Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time	IEC60950-1, 2nd Edition, IEC62368 Per MIL-HDBK-217F, ground benign, Tambient=+40°C Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient=+40°C	480	Yes TBD 3200 500		Hours x 10 ³ Hours x 10 ³ KHz
	IEC60950-1, 2nd Edition, IEC62368 Per MIL-HDBK-217F, ground benign, Tambient=+40°C Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient=+40°C Power on, Vout regulated	480	Yes TBD 3200 500 5	15	Hours x 10 ³ Hours x 10 ³ KHz MS
Calculated MTBF Calculated MTBF @ DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Startup Time Dynamic Load Response	IEC60950-1, 2nd Edition, IEC62368 Per MIL-HDBK-217F, ground benign, Tambient=+40°C Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient=+40°C Power on, Vout regulated Power on, Vout regulated Remote ON to Vout regulated 50-75-50% load step, settling time to within	480	Yes TBD 3200 500 5 5 5	15 10	Hours x 10 ^o Hours x 10 ^o KHz MS MS
Calculated MTBF Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Startup Time	IEC60950-1, 2nd Edition, IEC62368 Per MIL-HDBK-217F, ground benign, Tambient=+40°C Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient=+40°C Power on, Vout regulated Power on, Vout regulated S0-75-50% load step, settling time to within 1% of Vout.	480	Yes TBD 3200 500 5 5 5 5 50	15 10 150	Hours x 10 Hours x 10 KHz MS MS µSec
Calculated MTBF Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Startup Time Dynamic Load Response Dynamic Load Peak Deviation FEATURES and OPTIONS	IEC60950-1, 2nd Edition, IEC62368 Per MIL-HDBK-217F, ground benign, Tambient=+40°C Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient=+40°C Power on, Vout regulated Power on, Vout regulated S0-75-50% load step, settling time to within 1% of Vout.	480	Yes TBD 3200 500 5 5 5 5 50	15 10 150	Hours x 10 Hours x 10 KHz MS MS µSec
Calculated MTBF Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Startup Time Dynamic Load Response Dynamic Load Peak Deviation FEATURES and OPTIONS	IEC60950-1, 2nd Edition, IEC62368 Per MIL-HDBK-217F, ground benign, Tambient=+40°C Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient=+40°C Power on, Vout regulated Power on, Vout regulated S0-75-50% load step, settling time to within 1% of Vout.	480	Yes TBD 3200 500 5 5 5 5 50	15 10 150	Hours x 10 Hours x 10 KHz mS mS µSec
Calculated MTBF Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Startup Time Dynamic Load Response Dynamic Load Response Dynamic Load Peak Deviation FEATURES and OPTIONS Remote On/Off Control "N" suffix:	IEC60950-1, 2nd Edition, IEC62368 Per MIL-HDBK-217F, ground benign, Tambient=+40°C Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient=+40°C Power on, Vout regulated Power on, Vout regulated S0-75-50% load step, settling time to within 1% of Vout. same as above		Yes TBD 3200 500 5 5 5 5 50	15 10 150 ±200	Hours x 10 Hours x 10 KHz mS mS µSec
Calculated MTBF Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Startup Time Dynamic Load Response Dynamic Load Response Dynamic Load Peak Deviation FEATURES and OPTIONS Remote On/Off Control	IEC60950-1, 2nd Edition, IEC62368 Per MIL-HDBK-217F, ground benign, Tambient=+40°C Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient=+40°C Power on, Vout regulated Power on, Vout regulated S0-75-50% load step, settling time to within 1% of Vout.	480 -0.1 2.5	Yes TBD 3200 500 5 5 5 5 50	15 10 150	Hours x 10 ⁰ Hours x 10 ⁰ KHz mS mS µSec mV

ULS 60-Watt Series

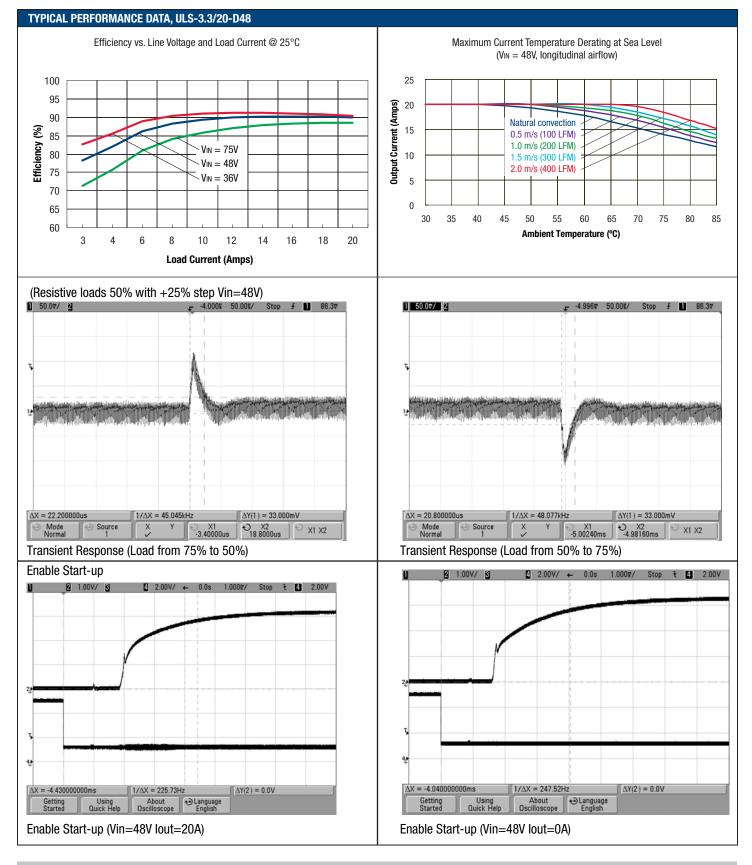
Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters

FUNCTIONAL SPECIFICATIONS, ULS-3.3/20-D48 (CONT.)

FEATURES and OPTIONS (cont.)	Conditions ①	Minimum	Typical/Nominal	Maximum	Units
Remote On/Off Control (cont.)					
"P" suffix:					
Positive Logic, ON state	ON = Pin open or external voltage	3.5		15	V
Positive Logic, OFF state	OFF = Ground pin or external voltage	0		1	V
Control Current	open collector/drain		1	2	mA
OUTPUT					
Total Output Power		0	66	66.66	W
Voltage					•
Nominal Output Voltage 3 (5)	No trim	3.267	3.3	3.333	Vdc
Settling Accuracy	At 50% load	-1		1	% of Vset
Output Voltage Range ®	User-adjustable	-10		10	
Overvoltage Protection	Via magnetic feedback	3.75	4.25	4.95	Vdc
Remote Sense Compensation	Of Vset ®		10		%
Current					,,,
Output Current Range		0	20	20	A
Minimum Load		0	No minimum load	20	
Current Limit Inception (3)	98% of Vnom., cold condition	22	26	30	A
Short Circuit ®		~~~~	20	50	A
Short offcult U	Hiccup technique, autorecovery within ±1%				
Short Circuit Current	of Vout		6.6		A
Short Circuit Duration (remove short for recovery)	Output shorted to ground, no damage		Continuous		
Short circuit protection method	Hiccup current limiting				
Regulation					
Line Regulation ⑦	Vin=min. to max., Vout=nom., nom load		±0.1		V
Load Regulation ⑦	lout=min. to max		±0.2		V
Ripple and Noise	5 Hz- 20 MHz BW		70	120	mV pk-pk
Temperature Coefficient	At all outputs		0.02		% of Vout./°C
Maximum Capacitive Loading (10% ceramic, 90% Oscon)	Low ESR, .02 ohms max (resistive load)		1000		μF
MECHANICAL (Through Hole Models)					
Outline Dimensions	Cxx case		1.3x0.9x0.4		Inches
(Please refer to outline drawing)	WxLxH		33x22.9x10.2		mm
Weight	WALAII		0.58		Ounces
Weight			16.4		Grams
Through Holo Din Diamator			.062 & .04		Inches
Through Hole Pin Diameter					
			1.575 & 1.016		mm
Thursday Hala Dia Matanial			Gold-plated copper		
Through Hole Pin Material			alloy with nickel		
			underplate		
TH Pin Plating Metal and Thickness	Nickel subplate		50		µ-inches
	Gold overplate		5		µ-inches
ENVIRONMENTAL					
Operating Ambient Temperature Range $\textcircled{0}$	No derating, full power, 200 LFM, no condensation	-40		85	°C
Storage Temperature	Vin = Zero (no power)	-55		125	°C
Operating Case Temp	No derating required	-40		120	0°C
Thermal Protection/Shutdown	Measured at hotspot	110	115	120	<u> </u>
		110	IIJ	120	U
Electromagnetic Interference	External filter is required		D		Close
Conducted, EN55022/CISPR22			B		Class
Radiated, EN55022/CISPR22			B		Class
RoHS rating			RoHS		

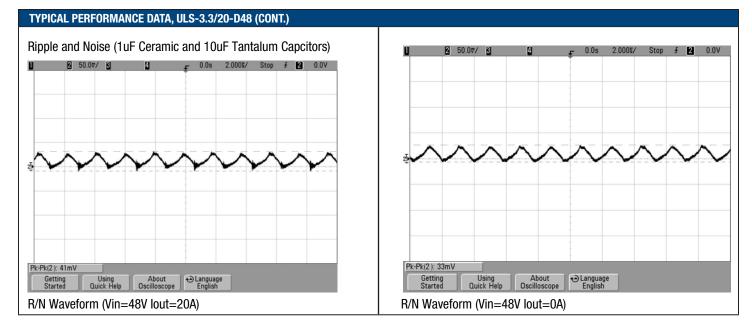
ULS 60-Watt Series

Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters



ULS 60-Watt Series

Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters



ULS 60-Watt Series

Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters

FUNCTIONAL SPECIFICATIONS, ULS-5/12-D48

ABSOLUTE MAXIMUM RATINGS	Conditions ①	Minimum	Typical/Nominal	Maximum	Units
Input Voltage, Continuous	Full power operation			80	Vdc
Input Voltage, Transient	Operating or non-operating, tested: 100 mS max. duration			100	Vdc
Isolation Voltage	Input to output			2250	Vdc
Input Reverse Polarity	None, install external fuse		None		Vdc
On/Off Remote Control	Power on, referred to -Vin	0		15	Vdc
Output Power		0		60.6	W
Output Current	Current-limited, no damage, short-circuit protected	0		12	A
Storage Temperature Range	Vin = Zero (no power)	-55		125	°C
	sure of devices to greater than any of these condition		ffect long_term reliability		-
	al Specifications Table is not implied or recommen		noot long torm ronability.		
INPUT		1404.			
Operating voltage range		36	48	75	Vdc
Recommended External Fuse	Fast blow	50	40	4	A
Start-up threshold, turn on	Rising input voltage	33	34.5	35.5	Vdc
• •					
Undervoltage shutdown, turn off (2)	Falling input voltage	31	32.5	33.5	Vdc
Overvoltage protection	None install		NA		Vdc
Reverse Polarity Protection	None, install external fuse		None		Vdc
Internal Filter Type			LC		
Input current					
Full Load Conditions	Vin = nominal		1.39	1.43	A
Low Line	Vin = minimum		1.85	1.91	A
Inrush Transient			0.05		A2-Sec.
Output in Short Circuit			100	200	mA
No Load input current	lout = minimum, unit=0N		40	80	mA
Shut-Down Mode Input Current			5	10	mA
Reflected (back) ripple current 2	no filtering		400	500	mAp-p
Reflected (back) ripple current 2	Measured at input with specified filter		25	35	mAp-p
GENERAL and SAFETY					
Efficiency	Vin=48V, full load	88	90		%
	Vin=Min	88	90		%
Isolation	· · ·				
Isolation Voltage, input to output				2250	Vdc
Insulation Safety Rating			basic		
Isolation Resistance			10		ΜΩ
Isolation Capacitance			1000		pF
Safety (meets the following requirements)	UL-60950-1, CSA-C22.2 No.60950-1, IEC60950-1, 2nd Edition, IEC62368		Yes		
Calculated MTBF	Per MIL-HDBK-217F, ground benign, Tambient=+40°C		TBD		Hours x 10 ³
Calculated MTBF ④	Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient=+40°C		3200		Hours x 10 ³
DYNAMIC CHARACTERISTICS					
Fixed Switching Frequency (19)			400		KHz
Startup Time	Power on, Vout regulated		10	20	mS
Startup Time	Remote ON to Vout regulated		10	20	mS
Dynamic Load Response	50-75-50% load step, settling time to within 1% of Vout.		50	100	µSec
Dynamic Load Peak Deviation	same as above		±200	±250	mV
FEATURES and OPTIONS			· · · · · ·		
Remote On/Off Control					
"N" suffix:					
"N" suffix:	ON = Pin grounded or external voltage	-0.1		0.8	V
	ON = Pin grounded or external voltage OFF = Pin open or external voltage	-0.1 2.5		0.8 15	V V

ULS 60-Watt Series

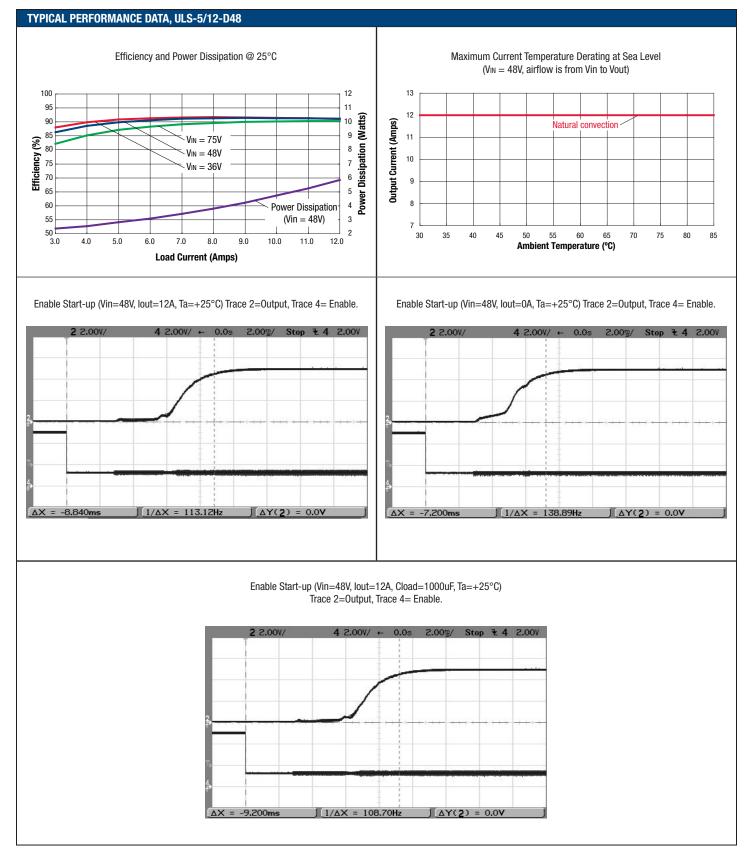
Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters

FUNCTIONAL SPECIFICATIONS, ULS-5/12-D48 (CONT.)

FEATURES and OPTIONS (cont.)	Conditions ①	Minimum	Typical/Nominal	Maximum	Units
Remote On/Off Control (cont.)					
"P" suffix:					
Positive Logic, ON state	ON = Pin open or external voltage	3.5		15	V
Positive Logic, OFF state	OFF = Ground pin or external voltage	0		1	V
Control Current	open collector/drain		1	2	mA
OUTPUT					
Total Output Power		0	60	60.6	W
Voltage					
Nominal Output Voltage 3 (5)	No trim	4.95	5	5.05	Vdc
Settling Accuracy	At 50% load	-1		1	% of Vset
Output Voltage Range ®	User-adjustable	-10		10	
Overvoltage Protection	Via magnetic feedback	6	6.5	7.2	Vdc
Remote Sense Compensation	Of Vset ®		10		%
Current					,0
Output Current Range		0	12	12	A
Minimum Load		0	No minimum load		~ ~ ~
Current Limit Inception (3)	98% of Vnom., after warm up	14	16	19	A
Short Circuit ®	50% of vitolit, after warm up	17	10	15	A
	Hiccup technique, autorecovery within ±1%				
Short Circuit Current	of Vout		0.5	1	A
Short Circuit Duration (remove short for recovery)	Output shorted to ground, no damage		Continuous		
Short circuit protection method	Hiccup current limiting				
Regulation					
Line Regulation \bigcirc	Vin=min. to max., Vout=nom., nom load		±0.125		V
Load Regulation ⑦	lout=min. to max		±0.25		V
Ripple and Noise	5 Hz- 20 MHz BW		50	100	mV pk-pk
Temperature Coefficient	At all outputs		0.02		% of Vout./°C
Maximum Capacitive Loading (10% ceramic, 90% Oscon)	Low ESR, .02 ohms max (resistive load)		220	1000	μF
MECHANICAL (Through Hole Models) Outline Dimensions	0.00		1.0+0.0+0.4		Inches
	Cxx case		1.3x0.9x0.4		Inches
(Please refer to outline drawing)	WxLxH		33x22.9x10.2		mm
Weight			0.58		Ounces
TI III D' D' I			16.4		Grams
Through Hole Pin Diameter			.062 & .04		Inches
			1.575 & 1.016		mm
T I I I I D' II I ' I			Gold-plated copper		
Through Hole Pin Material			alloy with nickel		
			underplate		
TH Pin Plating Metal and Thickness	Nickel subplate		50		µ-inches
	Gold overplate		5		µ-inches
ENVIRONMENTAL					
Operating Ambient Temperature Range 🕕	No derating, full power, 200 LFM, no condensation	-40		85	°C
Storage Temperature	Vin = Zero (no power)	-55		125	°C
Operating Case Temp	No derating required	-40		120	
Thermal Protection/Shutdown	Measured at hotspot	110	115	130	0°
Electromagnetic Interference	External filter is required	110	611	130	۰ ل
· · · · · · · · · · · · · · · · · · ·	External miler is required		Δ		Class
Conducted, EN55022/CISPR22			A		Class
Radiated, EN55022/CISPR22			A		Class
RoHS rating			RoHS		

ULS 60-Watt Series

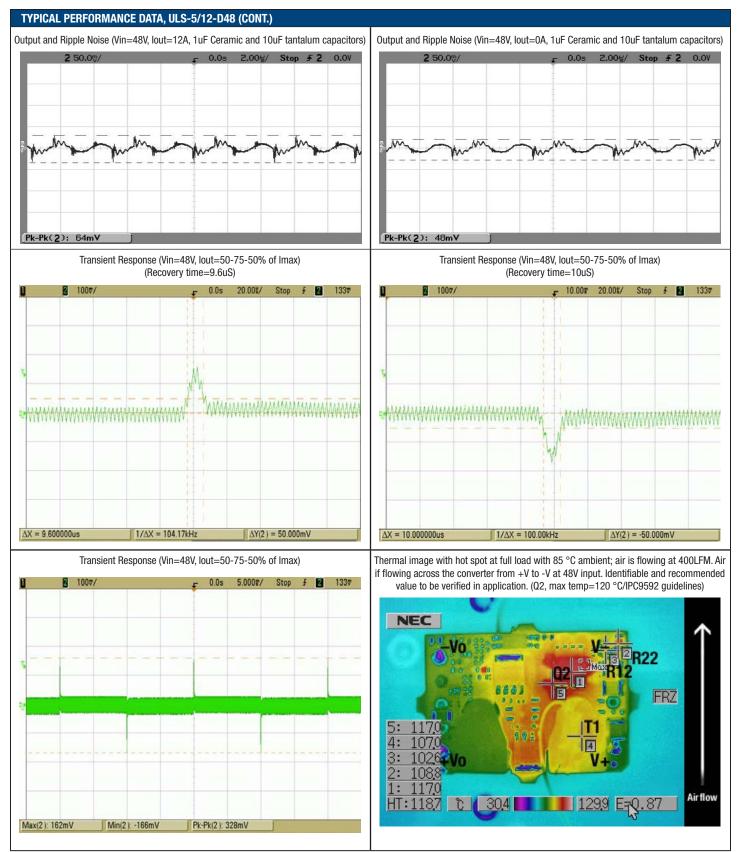
Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters



www.murata-ps.com/support

ULS 60-Watt Series

Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters



www.murata-ps.com/support

ULS 60-Watt Series

Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters

FUNCTIONAL SPECIFICATIONS, ULS-12/5-D48*

Operating or non-operating, tested: input Voltage, Transient Operating, tested: 100 mS max, duration 100 100 Isodation Voltage Input to output 2250 Voltage Input Persens Plantly None, install acternal fuse None Voltage Output Fower 0 60.6 W Output Current Shorage Temperature Range Vin – Zero (no power) -55 125 74 Storage Temperature Range Vin – Zero (no power) -55 125 74 Absolute maximum are stress ratings Superifications Table is not implied or recommended. WIN Programmediate Superifications Superifications may adversely affect long-term reliability. Proper operation under construction that intese listed in the Performance/Functional Superifications 36 48 75 Voltage Operating voltage range Fast blow 36 4 A A Orderovoltage shuthdown, turn off ® Fast blow 4 A A Orderovoltage shuthdown, turn off ® Fast blow 4 A A Orderovoltage shuthdown, turn off ® Fast blow 100 20.0 m <td< th=""><th>ABSOLUTE MAXIMUM RATINGS</th><th>Conditions ①</th><th>Minimum</th><th>Typical/Nominal</th><th>Maximum</th><th>Units</th></td<>	ABSOLUTE MAXIMUM RATINGS	Conditions ①	Minimum	Typical/Nominal	Maximum	Units
Input vortige Input to output Input to output Input to output Input Reverse Polarity Mone, Install external fuse None 2250 Vice Output Reverse Polarity Mone, Install external fuse 0 60.6 W Output Rever Current-Immiter, no damage, 0 60.6 W Storage Temperature Range Current-Immiter, no damage, 0 5 A Storage Temperature Range Vin - Zero (no power) -55 125 9 Abcolute maximums are stress ratings. Exposure of devices to greater than any of these conditions may adversely affect long-term reliability. Proper operation under conditions Mone 4 A MPUT Operating voltage range Fest blow 3 4.5 55 100 Becommended External Fuse Falling input voltage 31 22.5 33.5 100 Undersoftage shutdown, turn oft @ Falling input voltage 31 22.5 33.5 100 Becommended External Fuse None, install external fuse None, install 1.37 1.4.3 A Internal Filter	Input Voltage, Continuous				80	Vdc
Tot Tot max. function Califord Input to uright Input to uright 2250 Vid Input Reverse Polarity None, install external fase None Vid Output Durrent Curront-limited, no damage, obstance-functional specification proven) 0 60.6 WV Storage Temperature Range Vin - Zero (no poven) -55 125 9 Absolute maximums are stores ratings. Exposure of devices to greater than any of these conditions may advessity affect long-term reliability. Proper oporation under conditions that has itsel in the Performance-Functional Specifications Table is not implied or recommended. 4 A INPUT Operating voltage range Fast blow 4 A Recommended External Fase Fast blow 4 A Start-up threshold, turn on Raising input voltage 33 34.5 35.5 Vid Overvotage protection None, install external fuse None Vid Vid Vid Ingut External Fase Vin = moninal 1.37 1.43 A Low Line Vin = moninal 1.37 1.43 A <td< td=""><td>Innut Voltago, Transiant</td><td>Operating or non-operating, tested:</td><td></td><td></td><td>100</td><td>Vdo</td></td<>	Innut Voltago, Transiant	Operating or non-operating, tested:			100	Vdo
Input Reverse Polarity None, Install external fuse None 90 Output Power 0 60.6 W Output Current 0 60.6 W Strange Temperature Range Current-limited, no damage, short-directul protected 0 55 A Strange Temperature Range Vin – Zero (no power) -55 125 ~ Absolute maximums are strass ratings. Exposure of devices to granter than any of these conditions may adversely affect long-term reliability. Proper operation under conditions than those listed in the Performance/Functional Specifications Table is not implied or recommended. VMU 4 A Operating values Fast blow 3 4.5 5.5 10 Start-up threshold, turn on Reling input voltage 31 32.5 30 10 Overroltage protection None, install external fuse None 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10	input voltage, mansient	100 mS max. duration			100	vuc
On-Off Rende Control Power on, referred to -Vin. 0 15. Vid Output Power 0 60.6 W Output Current Current-Imited, no damago, to the stort-locating protected 0 5 A Storage Temperature Range Vin = Zaro (no power) -55 125 " Absolutin maximums are stores rafices to greater than are yor these conditions may adversely affectiong-term reliability. Proper operation under condition than those listed in the Performance/Functional Specifications Table is not implied or recommended. 36 48 75 Vid Overoiting protection Sature phresholds, turn on Rising input voltage 31 32.5 33.5 Vid Start-up thresholds, turn on Rising input voltage 31 32.5 33.5 Vid Overoitage protection None, install external fuse None Vid Vid Ingut current Vin = nominal 1.37 1.43 A Full Load Conditions Vin = nominal 1.37 1.43 A Low Line Vin = nominal 1.37 1.43 A Stut-Dow Mode Input	Isolation Voltage	Input to output			2250	Vdc
Output CurrentO60.6WDutput CurrentStort-circuit protected05AStorage Tomperature RangeVin = Zero (no power)-55125AAbcolate maximums are stores ratings. Exposure of devices to greater than any of these conditions may adversely affect long-term reliability. Proper operation under conditionNoAMarcolate maximums are stores ratings. Exposure of devices to greater than any of these conditions may adversely affect long-term reliability. Proper operation under conditionNoAMarcolate maximums are stores ratings. Exposure of devices to greater than any of these conditions may adversely affect long-term reliability. Proper operation under conditionNoAAMarcolate maximums are stores rating input voltage3334.535.5VioObrevoltage protectionRating input voltage3132.533.6VioOvervoltage protectionNone, install external fuseNoneVioOvervoltage protectionNone, install external fuseNoneVioFull cad ConditionsVin = nominal1.3.71.4.3AInsus fransientVin = minimum18.31.89AInsus fransientIout = minimum, unit=ON50150mShut-bow Mode input Current (M)No fact minimum, unit=ON1520mShut-bow Mode input Current (M)No fact minimum, unit=ON1520mShut-bow Mode input Current (M)No fact minimum, unit=ON1520mShut-bow Mode input Current (M)No fact	Input Reverse Polarity	None, install external fuse		None		Vdc
Current Current-Imiliad, no damage, both-circuit protected 0 5 A Absolute maximums are stress ratings. Exposure of devices to greater than any of these conditions may adversely affect long-term reliability. Proper operation under condition than those listed in the Performance/Purctional Specifications Table is not implied or recommended. 125 % NNUT Operating voltage range 6 48 75 Voltage range Becommended External Fuse Fast blow 6 48 75 Voltage range Becommended External Fuse Fast blow 6 48 75 Voltage range Becommended External Fuse Fast blow 6 48 75 Voltage range Becommended External Fuse Fast blow 31 32.5 33.5 Voltage range Internal Filter Type Internal Filter Type Capacitance Voltage range Voltager	On/Off Remote Control	Power on, referred to -Vin	0		15	Vdc
Unput currentshort-circuit protectedUSAStrage Temperature RangeVn = Zoro (no power)-5512.59.70Absolute maximums are strass ratings. Exposure of devices to greater than any of these conditions may adversely affect long-term reliability. Proper operation under conditionNoDyrating voltage range364875ViaGerating voltage range64.875ViaMeanmende External FuseFast blow34AAstart-up Intershoti, turn onRising input voltage3132.533.5ViaUndervoltage studiutom, turn of (©Falling input voltage3132.533.5ViaOvervoltage protectionNone, install external fuseNoneViaViaPerser Polarity ProtectionNone, install external fuseNoneViaViaInternal Filter TypeInternal fuseNoneViaViaFull cad ConditionsVin = nominal1.3.71.4.3AInsus TransientInternal fuse10.0.5A2.5MinInsus TransientIout = minimum, unit=0N1525mShut-Dow Mode Input Current (M)IS20.0mA/MinReflected (back) rippic current 2:Measured at input with specified filter1530mA/Shut-Dow Mode Input Current (M)Inform (M)88919191Shut-Dow Mode Input Current 2:Measured at input with specified filter1530mA/Shut-Dow Mode Input Current (M	Output Power		0		60.6	W
short-orcult protected -55 125 "" Absolute maximums are stess ratings. Exposure of devices to greater than any of these conditions may adversely affect long-term reliability. Proper operation under condition than those listed in the Performance/Functional Specifications Table is not implied or recommended. Void these conditions may adversely affect long-term reliability. Proper operation under condition than those listed in the Performance/Functional Specifications Table is not implied or recommended. Void these conditions may adversely affect long-term reliability. Proper operation under condition than the theoreman. Void these conditions may adversely affect long-term reliability. Proper operation under condition that the theoreman. Void theoreman. NPUT Conditions 18 inity prutvaltage 33 34-5 55.5 Void theoreman. Start-up thresholds, furn on Reinse viant void trage 31 32.5 33.5 Void Undervoltage shutdown, turn off @ No Overvoltage protection None, install external fuse None No No No Full cad Conditions Vin = nominal 1.37 1.43 A Low Line Vin = minimum, unit=ON 100 20.0 mm No Lad input current { No Lad input current { No filtering 15. 2.5 <td>Output Current</td> <td></td> <td>0</td> <td></td> <td>5</td> <td>А</td>	Output Current		0		5	А
Absolute maximums are stress ratings. Exposure of devices to greater than any of these conditions may adversely affect long-term reliability. Proper operation under condition than those listed in the Performance/Functional Specifications Table is not implied or recommended	•	· · · · · · · · · · · · · · · · · · ·	-			
than these listed in the Performance/Functional Specifications Table is not implied or recommended. WPUT Operating voltage range 36 48 75 Viol Operating voltage range Fast blow 3 34.5 35.5 Viol Recommended External Fuse Fast blow 3 34.5 35.5 Viol Start-g thresholds, turn oft @ Falling input voltage 31 32.5 33.5 Viol Overvoltage protection NA NA Viol				faat lang tarm raliability	-	-
NPUT 36 48 75 Vide Recommended External Fuse Fast blow 3 34.5 35.5 Vide Recommended External Fuse Fast blow 3 34.5 35.5 Vide Recommended External Fuse Fast blow 33 34.5 35.5 Vide Modervoltage struktown, turn off © Falling input voltage 31 32.5 33.5 Vide Modervoltage struktown, turn off © Falling input voltage 31 32.5 33.5 Vid Modervoltage struktown, turn off © None, install external fuse None Vide Vide Ingut current Internal Filter Type None Vin Na A2.5 Full Cad Conditions Vin = minimum 18.3 1.89 A Inrush Transient 0.01 100 200 m No Load input current Inst-Town Mode Input Current (TH) Stut-Down Mode Input Current (SM) Sol Masured at input with specifie				nectiong-term reliability.	Proper operation unde	
Operating voltage range 0 36 48 75 V/0 Recommended External Fuse Fast blow 4 A Recommended External Fuse Rising input voltage 33 34.5 35.5 V/0 Start-up threshold, turn oft @ Falling input voltage 33 34.5 35.5 V/0 Overvoltage protection None NA V/0 V/0 V/0 V/0 Reverse Polarity Protection None, install external fuse None V/0 V/0 Ingut current Capacitance V/0 V/0 A A Insuch Transient 1.0 1.00 200 rm No Lead input current (TH) 15 20 rm Shut-Down Mode Input Current (SMT) 150 200 rmA Reflected (back) riple current 2 mo filtering 150 200 rmA Reflected (back) riple current 2 mo filtering 150 200 rmA Reflected (back) riple current 2 <td></td> <td>al specifications fable is not implied of recommen</td> <td>ided.</td> <td></td> <td></td> <td></td>		al specifications fable is not implied of recommen	ided.			
Recommended External Puse Fast blow 4 A Start-up threshold, turn on Rising input voltage 33 34.5 35.5 Vid Odervoltage protection 0 Raling input voltage 31 32.5 33.5 Vid Overvoltage protection 0 None Vid None Vid Reverse Polarity Protection None, install external fuse None Vid Vid Input current 1.37 1.43 A A A Full Load Conditions Vin = nominal 1.37 1.43 A Low Line Vin = minimum 1.83 1.89 A Inrush Transiert 0.01 100 200 m No Load input Current (TH) 100 200 m Shut-Down Mode Input Current (SMT) 15 25 m Shut-Down Mode Input Current (SMT) no filtering 150 200 mA Reflected (back) ripple current 0 no filtering 150 20 mA Shut-Down Mode Input Current (SMT)			200	40	75	Vala
Start-up threshold, turn on Rising input voltage 33 34.5 35.5 Vid Overvoltage shutdown, turn off @ Falling input voltage 31 32.5 33.5 Vid Overvoltage protection NA NA Vid Vid Reverse Polarity Protection None, install external fuse NA Vid Internal Filter Type Capacitance Vid Internal Filter Type Capacitance Vid Internal Filter Type 1.37 1.43 A Low Line Vin = nominal 1.37 1.43 A Low Line Vin = nominal 1.37 1.43 A Start-Dow Mode Input Current (Yih) 100 200 m Shut-Dow Mode Input Current (SMT) 15 25 m Shut-Dow Mode Input Current (SMT) 155 20 mA Reflected (back) ripple current 20 Measured at input with specified filter 15 30 mA Ideltering Vin-Min (Th) 89 90 90 90 90		Fast blaur	30	48		
Undervoltage shutdown, turn off ⊕ Falling input voltage 31 32.5 33.5 Voltage Overvoltage protection None, install external fuse NA Voltage Reverse Vairity Protection None, install external fuse NA Voltage Reverse Vairity Protection None, install external fuse Na Voltage Ingut current Un = nominal 1.37 1.43 A Ingut current Un = nominal 1.37 1.43 A Ingut current Un = nominal 0.05 A2-5 Output in Short Circuit 100 200 m No Load ingut current Iout= minimum, unit=0N 50 150 m Shut-Down Mode Ingut Current (SMT) 15 20 m m Reflected (back) ripple current © Measured at ingut with specified filter 15 20 m Shut-Down Mode Ingut Current (SMT) Measured at ingut with specified filter 15 20 m Shut-Down Mode Ingut Current (SMT) Measured at ingut with specified filter 15 20 M			00	04.5		
Overvoltage protection NA V/d Reverse Polarity Protection None, install external fuse None V/d Reverse Polarity Protection None, install external fuse None V/d Input current	* *					
Reverse Polarity Protection None, install external fuse None Vid Internal Filter Type Capacitance Capacitance Vid Full Load Conditions Vin = nominal 1.3.7 1.4.3 A Low Line Vin = nominal 1.3.7 1.4.3 A Inrush Transient 0.05		Falling input voltage	31		33.5	Vdc
Internal Filter Type Capacitance Input current						Vdc
Input current Vin = nominal 1.37 1.43 A Full Load Conditions Vin = minimum 1.83 1.89 A Inrush Transient Vin = minimum 1.83 1.89 A Inrush Transient 0.05 200 mt No Load input current Iout = minimum, unit=0N 50 150 m Shut-Down Mode Input Current (SMT) 15 20 m Reflected (back) ripple current @ Measured at input with specified filter 15 20 mA Reflected (back) ripple current @ Measured at input with specified filter 150 200 mA Reflected (back) ripple current @ Measured at input with specified filter 15 30 mA Reflected (back) ripple current @ Measured at input with specified filter 15 30 mA Reflected (back) ripple current @ Measured at input with specified filter 15 30 mA Stafet (measure at input with specified filter 150 200 mA Ma Ma Ma Ma Ma Ma Ma		None, install external fuse				Vdc
Full Load Conditions Vin = nominal 1.37 1.43 AA Low Line Vin = minimum 1.83 1.89 AA Inrush Transient 0.05 242-5 A Output in Short Circuit 100 200 m No Load input current (TH) 100 200 m Shut-Down Mode Input Current (SMT) 15 25 m Shut-Down Mode Input Current (SMT) 15 20 mA Reflected (back) ripple current ② Measured at input with specified filter 15 30 mAA GENERAL and SAFETY Efficiency Vin=Min (TH) 88 91 % Efficiency Vin=Min (TH) 89 90 % % Isolation Netage, input to output 1000 M % % Insultion Safety Rating 1000 M M M Isolation Resistance 1000 M M M Isolation Resistance 1000 M M M Isolation Capacitance (TH)				Capacitance		
Low Line Vin = minimum 1.83 1.89 A Inrush Transient 0.05 0.05 A2-5 Output in Short Circuit 100 200 mm No Load input current lout = minimum, unit=0N 50 150 mm Shut-Down Mode Input Current (SMT) 15 25 mm Reflected (back) ripple current @ no filtering 150 200 mA Reflected (back) ripple current @ Measured at input with specified filter 15 30 mA GNIRAL and SAFETY Tim=48V, full load 88 91 % CNIRAL and SAFETY Vin=48V, full load 88 91 % Stolation Voltage, input to output Vin=Min (SMT) 89 90. % Isolation Chapacitance (RM) Vin=Min (SMT) 89 91.5 % Isolation Chapacitance (RM) Vin=Min (SMT) 89 91.5 % Isolation Chapacitance (RM) Vin=Min (SMT) 89 91.5 % Isolation Chapacitance (RM) 1000 Min SM </td <td>•</td> <td>1</td> <td></td> <td></td> <td></td> <td></td>	•	1				
Inrush Transient 0.05 A2-5 Output in Short Circuit 100 200 m No Load input Current (TH) 1001 100 200 m Shut-Down Mode Input Current (SMT) 15 25 m Shut-Down Mode Input Current (SMT) 15 20 m Reflected (back) ripple current ② Measured at input with specified filter 15 30 mA1 GENERAL and SAFETY 15 30 mA1 Efficiency Vin=48y, full load 88 91 % Vin=Min (TH) 89 90 % % Isolation Vin=Min (SMT) 89 91.5 % Isolation Capacitance (TH) 1000 MM M % Isolation Capacitance (SMT) 1000 MM monsiten exercises % Safety (meets the following requirements) UL-60950-1, CSA-C22.2 No.60950-1, IEC60950.8 Yes F Safety (meets the following requirements) UL-60950-1, CSA-C22.2 No.60950-1, IEC60950.8 Yes F Safety						A
Output in Short Circuit Incload 100 200 m No Load input current lout = minimum, unit=0N 50 150 mm Shut-Down Mode Input Current (SMT) incload 15 25 m Shut-Down Mode Input Current (SMT) incload 15 20 mm Reflected (back) ripple current @ Measured at input with specified filter 15 30 mA/ Reflected (back) ripple current @ Measured at input with specified filter 15 30 mA/ Reflected (back) ripple current @ Measured at input with specified filter 15 30 mA/ GANERAL and SAFETY Efficiency Vin=48V, full load 88 91 % Gation Un=Min (TH) 89 90. % % Isolation Safety Rating 100 2250 % Isolation Resistance 100 M M Isolation Capacitance (SMT) IEC60950-1, CSA-C22.2 No.60950-1, IEC62368 Yes Mouss Calculated MTBF Per MIL-HDBK-217F, ground henign, Tambient=+40°C Tambient		Vin = minimum			1.89	A
No Load input currentlout = minimum, unit=ON50150mShut-Down Mode Input Current (IM)1525mShut-Down Mode Input Current (SMT)155200mAReflected (back) ripple current (2)Measured at input with specified filter1530mAReflected (back) ripple current (2)Measured at input with specified filter1530mAReflected (back) ripple current (2)Vin=48V, full load889191Reflected (back) ripple current (2)Vin=48V, full load889191SolationVin=48V, full load889191Status TimeVin=Min (SMT)89909090IsolationVin=Min (SMT)8991.590Isolation Capacitance (TH)100MMIsolation Capacitance (TH)1000M1500plIsolation Capacitance (SMT)UL-60950-1, CSA-C22.2 No.60950-1, ICCG2368Yes1500plSafety (meets the following requirements)UL-60950-1, CSA-C22.2 No.60950-1, ICCG2368YesHoursCalculated MTBFPer MIL-HDBK-217F, ground benign, Tambient=+40°C3200HoursVNAMIC CHARACTERISTICS470520570KHStartup Time (3MT)Remote ON to Vout regulated30mStartup Time (SMT)Remote ON to Vout regulated30mStartup Time (SMT)Remote ON to Vout regulated20mStartup Time (SMT)Remote ON to Vout regulated20m <td></td> <td></td> <td></td> <td></td> <td></td> <td>A2-Sec.</td>						A2-Sec.
Shut-Down Mode Input Current (TH) 15 25 m Shut-Down Mode Input Current (SMT) no filtering 15 20 m Reflected (back) ripple current @ Measured at input with specified filter 15 30 mAl Reflected (back) ripple current @ Measured at input with specified filter 15 30 mAl GENERAL and SAFETY 15 30 mAl Efficiency Vin=48V, full load 88 91 % Vin=Min (TH) 89 90 % Isolation 2250 Md Isolation Voltage, input to output 2250 Md Isolation Capacitance (TH) basic Isolation Capacitance (TH) 1000 MM Isolation Capacitance (TH) 1000 Md Isolation Capacitance (TH) 1500 pt Isolation Capacitance (TH) 16000 pt Safety (meets						mA
Shut-Down Mode Input Current (SMT) no filtering 15 20 m Reflected (back) ripple current (2) Measured at input with specified filter 15 30 mAl GENERAL and SAFETY 15 30 mAl Edition Voltage, input to output Nin=Min (TH) 89 90 % Isolation Vin=Min (SMT) 89 91.5 % Isolation Voltage, input to output 2250 Vid Isolation Capacitance (TH) 1000 M Isolation Capacitance (SMT) 1000 M M Isolation Capacitance (SMT) UL-60950-1, CSA-C22.2 No.60950-1, ICCS238 Yes Ves Calculated MTBF Per MIL-HDBK-217F, ground benign, Tambient=+40°C Yes Ves Ves Calculated MTBF ® Per Calculared Ar32a, issue 1, class 3, ground fixed, Tambient=+40°C 30 M <td>No Load input current</td> <td>lout = minimum, unit=0N</td> <td></td> <td></td> <td></td> <td>mA</td>	No Load input current	lout = minimum, unit=0N				mA
Reflected (back) ripple current ② no filtering 150 200 mAj Reflected (back) ripple current ③ Measured at input with specified filter 15 30 mAj GENERAL and SAFETY 15 30 mAj Efficiency Vin=48V, full load 88 91 % Vin=Min (TH) 89 90 % Isolation Voltage, input to output 89 91.5 % Insulation Safety Rating basic 2250 Vd Isolation Resistance basic 1000 MM Isolation Capacitance (TH) 1000 MM Mousaic Mousaic Isolation Capacitance (SMT) UL-60950-1, CSA-C22.2 No.60950-1, IEC60950-1, 2nd Edition, IEC62368 Yes Mours Calculated MTBF Per MIL-HDBK-217F, ground benign, Tambient=+40°C TBD Hours OVNAMIC CHARACTERISTICS fixed, Tambient=+40°C 3200 Hours Startup Time Power on, Vout regulated 30 m Startup Time (TH) Remote ON to Vout regulated 30 m Startup Time (SMT) Serve ton Vout regulated 30 m				-		mA
Reflected (back) ripple current ② Measured at input with specified filter 15 30 mAj GENERAL and SAFETY % Efficiency Vin=48V, full load 88 91 % % Efficiency Vin=Min (TH) 89 90 % % Isolation Voltage, input to output 2250 Vol Isolation Resistance 2250 Vol Isolation Capacitance (TH) <t< td=""><td>Shut-Down Mode Input Current (SMT)</td><td></td><td></td><td></td><td>20</td><td>mA</td></t<>	Shut-Down Mode Input Current (SMT)				20	mA
GENERAL and SAFETY Vin=48V, full load 88 91 % Efficiency Vin=48V, full load 88 91 % Vin=Min (TH) 89 90 % Isolation Vin=Min (SMT) 89 91.5 % Isolation Voltage, input to output 2250 Vol Insulation Safety Rating basic M Isolation Resistance 100 M M M M Isolation Capacitance (TH) 1000 M M D D M M M M M M M M M M M M M M M M M M M M M M M M M M M M M M M M M M M M M M M M M M M M M M M M M M M M M M M	Reflected (back) ripple current 2	no filtering		150	200	mAp-p
EfficiencyVin=48V, full load889199Vin=Min (TH)89909090IsolationVin=Min (SMT)8991.590IsolationVin=Min (SMT)8991.590Isolation Voltage, input to output02250VolInsulation Safety Rating0100M.Isolation Capacitance (TH)100000Isolation Capacitance (SMT)150000Safety (meets the following requirements)UL-60950-1, CSA-C22.2 No.60950-1, IEC62368Yes15000Calculated MTBFPer MIL-HDBK-217F, ground benign, Tambient=+40°CTBDHoursDYNAMIC CHARACTERISTICSPer Telcordia SR332, issue 1, class 3, ground fixed, Tambient=+40°C3200HoursStartup TimePower on, Vout regulated300mStartup Time (FM)Remote ON to Vout regulated30mStartup Time (SMT)Remote ON to Vout regulated2250µSDynamic Load Response50-75-50% load step, settling time to within 1% of Vout.2550µS	Reflected (back) ripple current 2	Measured at input with specified filter		15	30	mAp-p
Vin=Min (TH)8990%Isolation Voltage, input to output8991.5%Isolation Voltage, input to output2250Voltage, input to outputIsolation Voltage, input to output2250Voltage, input to outputIsolation Resistance100MIsolation Capacitance (TH)1000plIsolation Capacitance (SMT)1500plSafety (meets the following requirements)UL-60950-1, CSA-C22.2 No.60950-1, IEC62368YesfCalculated MTBFPer MIL-HDBK-217F, ground benign, Tambient=+40°CTBDHoursCalculated MTBF @Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient=+40°C3200HoursDYNAMIC CHARACTERISTICSPer Telcordia SR332, issue 1, class 3, ground fixed, Tambient=+40°C30mStartup TimePower on, Vout regulated30mStartup Time (TH)Remote ON to vout regulated30mStartup Time (SMT)So-75-50% load step, settling time to within 1% of Vout.2550µS	GENERAL and SAFETY					
IsolationNin=Min (SMT)8991.5%Isolation Voltage, input to output2250VoltIsolation Safety RatingbasicIsolation Safety Rating100MMIsolation Capacitance (TH)1000MMIsolation Capacitance (SMT)1500Safety (meets the following requirements)UL-60950-1, CSA-C22.2 No.60950-1, IEC60958YesCalculated MTBFTBDHoursCalculated MTBF @Per MIL-HDBK-217F, ground benign, Tambient=+40°C3200HoursDYNAMIC CHARACTERISTICS470520570KHStartup TimePower on, Vout regulated300mStartup Time (SMT)Remote ON to Vout regulated30mStartup Time (SMT)Remote ON to Vout regulated20mDynamic Load Response50-75-50% load step, settling time to within 1% of Vout.2550µS	Efficiency	Vin=48V, full load	88	91		%
IsolationSolation Voltage, input to output2250Voltage, input to outputIsolation Voltage, input to outputIsolation Capacitance2250Voltage, input to outputIsolation Resistance100basicIsolation Resistance100Isolation Capacitance (TH)10001000plIsolation Capacitance (SMT)UL-60950-1, CSA-C22.2 No.60950-1, IEC60368YesIsolation CapacitanceCalculated MTBFPer MIL-HDBK-217F, ground benign, Tambient=+40°CTBDHoursCalculated MTBF @Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient=+40°C3200HoursDYNAMIC CHARACTERISTICS470520570KHStartup TimePower on, Vout regulated30mStartup Time (SMT)Remote ON to Vout regulated20mDynamic Load Response50-75-50% load step, settling time to within 1% of Vout.2550µS		Vin=Min (TH)	89	90		%
Isolation Voltage, input to output2250VdInsulation Safety Ratingbasic100Isolation Resistance100MMIsolation Capacitance (TH)1000plIsolation Capacitance (SMT)1500plSafety (meets the following requirements)UL-60950-1, CSA-C22.2 No.60950-1, 1EC60950-1, 2nd Edition; IEC62368YesCalculated MTBFPer MIL-HDBK-217F; ground benign, Tambient=+40°CTBDHoursCalculated MTBF @Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient=+40°C3200HoursDYNAMIC CHARACTERISTICSPower on, Vout regulated30mStartup TimePower on, Vout regulated30mStartup Time (TH)Remote ON to Vout regulated20mStartup Time (SMT)Remote ON to Vout regulated20mDynamic Load Response50-75-50% load step, settling time to within 1% of Vout.2550µS		Vin=Min (SMT)	89	91.5		%
Insulation Safety RatingbasicIsolation Resistance100MtIsolation Capacitance (TH)1000plIsolation Capacitance (SMT)1000plSafety (meets the following requirements)UL-60950-1, CSA-C22.2 No.60950-1, 1500plCalculated MTBFUL-60950-1, 2nd Edition; IEC62368YesresCalculated MTBFPer MIL-HDBK-217F, ground benign, Tambient=+40°CTBDHoursDYNAMIC CHARACTERISTICSPer Telcordia SR332, issue 1, class 3, ground fixed, Tambient=+40°C3200HoursStartup TimePower on, Vout regulated30mStartup Time (TH)Remote ON to Vout regulated30mStartup Time (SMT)Remote ON to Vout regulated20mDynamic Load Response50-75-50% load step, settling time to within 1% of Vout.2550µS	Isolation	• • • • • •				·
Isolation Resistance100Mt.Isolation Capacitance (TH)1000plIsolation Capacitance (SMT)1500plSafety (meets the following requirements)UL-60950-1, CSA-C22.2 No.60950-1, IEC60950-1, 2nd Edition; IEC62368YesCalculated MTBFPer MIL-HDBK-217F; ground benign, Tambient=+40°CTBDHoursCalculated MTBF @Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient=+40°C3200HoursDYNAMIC CHARACTERISTICSFrequency @470520570KHStartup TimePower on, Vout regulated300mStartup Time (TH)Remote ON to Vout regulated300mStartup Time (SMT)Remote ON to Vout regulated20mDynamic Load Response50-75-50% load step, settling time to within 1% of Vout.2550µSi	Isolation Voltage, input to output				2250	Vdc
Isolation Capacitance (TH)1000plIsolation Capacitance (SMT)1500plSafety (meets the following requirements)UL-60950-1, CSA-C22.2 No.60950-1, IEC60950-1, 2nd Edition; IEC62368YesfCalculated MTBFPer MIL-HDBK-217F, ground benign, Tambient=+40°CTBDHoursCalculated MTBF ④Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient=+40°C3200HoursDYNAMIC CHARACTERISTICSFFHoursHoursStartup TimePower on, Vout regulated300mStartup Time (TH)Remote ON to Vout regulated300mStartup Time (SMT)Remote ON to Vout regulated20mDynamic Load Response50-75-50% load step, settling time to within 1% of Vout.2550µSi	Insulation Safety Rating			basic		
Isolation Capacitance (SMT)1500plSafety (meets the following requirements)UL-60950-1, CSA-C22.2 No.60950-1, IEC60950-1, 2nd Edition; IEC62368YesIEC60950-1, YesCalculated MTBFPer MIL-HDBK-217F, ground benign, Tambient=+40°CTBDHoursCalculated MTBF ④Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient=+40°C3200HoursDYNAMIC CHARACTERISTICSFixed, Tambient=+40°C3200HoursDYNAMIC CHARACTERISTICSFixed switching Frequency Startup TimePower on, Vout regulated300mStartup Time (TH)Remote ON to Vout regulated300mStartup Time (SMT)Remote ON to Vout regulated20mDynamic Load Response50-75-50% load step, settling time to within 1% of Vout.2550µSs	Isolation Resistance			100		MΩ
Safety (meets the following requirements)UL-60950-1, CSA-C22.2 No.60950-1, IEC60950-1, 2nd Edition; IEC62368YesCalculated MTBFPer MIL-HDBK-217F, ground benign, Tambient=+40°CTBDHoursCalculated MTBF @Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient=+40°C3200HoursDYNAMIC CHARACTERISTICSFixed, Tambient=+40°C3200HoursFixed Switching Frequency @Power on, Vout regulated300mStartup TimePower on, Vout regulated300mStartup Time (SMT)Remote ON to Vout regulated300mDynamic Load Response50-75-50% load step, settling time to within 1% of Vout.2550µSi	Isolation Capacitance (TH)			1000		pF
Satety (meets the following requirements)IEC60950-1, 2nd Edition; IEC62368YesCalculated MTBFPer MIL-HDBK-217F, ground benign, Tambient=+40°CTBDHoursCalculated MTBF ④Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient=+40°C3200HoursDYNAMIC CHARACTERISTICSFrequency ④470520570KHStartup TimePower on, Vout regulated300mStartup Time (TH)Remote ON to Vout regulated300mStartup Time (SMT)Remote ON to Vout regulated20mDynamic Load Response50-75-50% load step, settling time to within 1% of Vout.2550µSi	Isolation Capacitance (SMT)			1500		pF
Calculated MTBFTambient=+40°CTBDHoursCalculated MTBF ④Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient=+40°C3200HoursDYNAMIC CHARACTERISTICSFixed Switching Frequency ⑨Power on, Vout regulated300mStartup TimePower on, Vout regulated300mStartup Time (TH)Remote ON to Vout regulated300mStartup Time (SMT)Remote ON to Vout regulated20mDynamic Load Response50-75-50% load step, settling time to within 1% of Vout.2550µSi	Safety (meets the following requirements)			Yes		
Calculated MTBF ④Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient=+40°C3200HoursDYNAMIC CHARACTERISTICSFixed Switching Frequency ⑥470520570KHStartup TimePower on, Vout regulated30mStartup Time (TH)Remote ON to Vout regulated30mStartup Time (SMT)Remote ON to Vout regulated20mDynamic Load Response50-75-50% load step, settling time to within 1% of Vout.2550µSi	Calculated MTBF	Per MIL-HDBK-217F, ground benign,		TBD		Hours x 10 ³
DYNAMIC CHARACTERISTICS Fixed Switching Frequency (a) 470 520 570 KH Startup Time Power on, Vout regulated 30 m Startup Time (TH) Remote ON to Vout regulated 30 m Startup Time (SMT) Remote ON to Vout regulated 20 m Dynamic Load Response 50-75-50% load step, settling time to within 1% of Vout. 25 50 µSi	Calculated MTBF ④	Per Telcordia SR332, issue 1, class 3, ground		3200		Hours x 10 ³
Fixed Switching Frequency (1)Power on, Vout regulated470520570KHStartup TimePower on, Vout regulated30mStartup Time (TH)Remote ON to Vout regulated30mStartup Time (SMT)Remote ON to Vout regulated20mDynamic Load Response50-75-50% load step, settling time to within 1% of Vout.2550µSi	DYNAMIC CHARACTERISTICS				I	
Startup TimePower on, Vout regulated30mStartup Time (TH)Remote ON to Vout regulated30mStartup Time (SMT)Remote ON to Vout regulated20mDynamic Load Response50-75-50% load step, settling time to within 1% of Vout.2550µSi			470	520	570	KHz
Startup Time (TH)Remote ON to Vout regulated30mStartup Time (SMT)Remote ON to Vout regulated20mDynamic Load Response50-75-50% load step, settling time to within 1% of Vout.2550µSt		Power on Vout regulated		020		mS
Startup Time (SMT) Remote ON to Vout regulated 20 m Dynamic Load Response 50-75-50% load step, settling time to within 1% of Vout. 25 50 pus						mS
Dynamic Load Response 50-75-50% load step, settling time to within 1% of Vout. 25 50 µSi						mS
	,	50-75-50% load step, settling time to within		25		μSec
Dynamic Load Peak Deviation same as above ±180 ±240 m	Dynamia Load Book Deviation			±100	+240	mV

*NOTE: The ULS-12/5-D48NM-C (SMT version) contains ceramic capacitors. No tantalum capacitors are used.

ULS 60-Watt Series

Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters

FUNCTIONAL SPECIFICATIONS, ULS-12/5-D48 (CONT.)

FEATURES and OPTIONS	Conditions ①	Minimum	Typical/Nominal	Maximum	Units
Remote On/Off Control					
"N" suffix:					
Negative Logic, ON state	ON = Pin grounded or external voltage	-0.1		0.8	V
Negative Logic, OFF state	OFF = Pin open or external voltage	2.5		15	V
Control Current	open collector/drain		1	2	mA
"P" suffix:					
Positive Logic, ON state	ON = Pin open or external voltage	3.5		15	V
Positive Logic, OFF state	OFF = Ground pin or external voltage	0		1	V
Control Current	open collector/drain		1	2	mA
OUTPUT			-		
Total Output Power		0	60	60.6	W
Voltage		0	00	00.0	
Nominal Output Voltage 3 (5)	No trim 🔞	11.88	12	12.12	Vdc
Settling Accuracy	At 50% load	-1	12	1	% of Vset
					70 UI VSEL
Output Voltage Range (TH) ®	User-adjustable	-10		10	
Output Voltage Range (SMT) ®	User-adjustable	-15		10	
Overvoltage Protection	Via magnetic feedback	13.3	14.5	18	Vdc
Remote Sense Compensation	Of Vset		10		%
Current					
Output Current Range		0	5	5	A
Minimum Load			No minimum load		
Current Limit Inception (1)	98% of Vnom., after warm up	5.5	6.8	8	A
Short Circuit (5)					
Short Circuit Current	Hiccup technique, autorecovery within ±1% of Vout		0.6		А
Short Circuit Duration (remove short for recovery)	Output shorted to ground, no damage		Continuous		
Short circuit protection method	Hiccup current limiting				
Regulation					
Line Regulation ⑦	Vin=min. to max., Vout=nom., nom load		±0.125		V
Load Regulation 7	lout=min. to max		±0.25		V
Ripple and Noise	5 Hz- 20 MHz BW		80	120	mV pk-pk
Temperature Coefficient	At all outputs		0.02	120	% of Vout./°C
Maximum Capacitive Loading	At all outputs		0.02		/0 01 V001./ 0
(10% ceramic, 90% Oscon)	Low ESR, .02 ohms max (resistive load)			2200	μF
· · ·	landa 00 mente				
Maximum Capacitive Loading	loads: CC mode				μF
MECHANICAL (Through Hole Models)	0		1.0-0.0-0.4		lu ch c c
Outline Dimensions	Cxx case		1.3x0.9x0.4		Inches
(Please refer to outline drawing)	WxLxH		33x22.9x10.2		mm
Weight			0.58		Ounces
			16.4		Grams
Through Hole Pin Diameter			.062 & .04		Inches
			1.575 & 1.016		mm
Through Hole Pin Material			Gold-plated copper alloy with nickel		
TH Din Blating Motal and Thickness	Niekol autolata		underplate		u inchoc
TH Pin Plating Metal and Thickness	Nickel subplate		50		µ-inches
ENVIRONMENTAL	Gold overplate		5		µ-inches
	No devotion full course 000 LEM				
Operating Ambient Temperature Range 🕦	No derating, full power, 200 LFM, no condensation	-40		85	°C
Storage Temperature	Vin = Zero (no power)	-55		125	0°
Operating Case Temp	No derating required	-40		105	°C
Thermal Protection/Shutdown	Measured at hotspot	115	125	130	°C
Electromagnetic Interference	External filter is required				
Conducted, EN55022/CISPR22	· · · · · · · · · · · · · · · · · · ·		В		Class
Radiated, EN55022/CISPR22			B		Class
RoHS rating			RoHS		

ULS 60-Watt Series

Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters

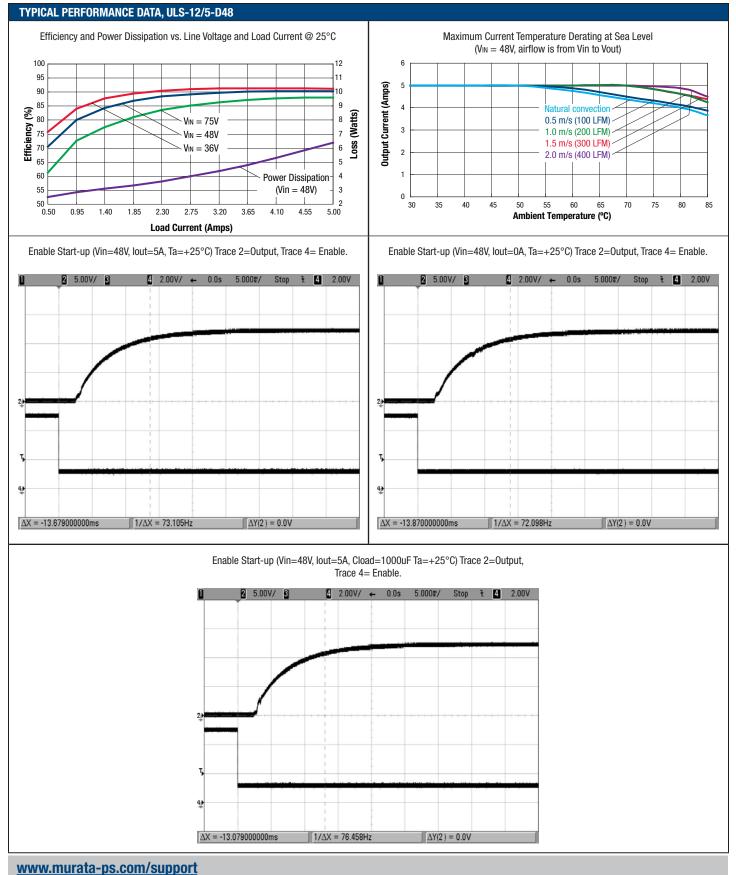
Performance Specification Notes

- O All specifications are typical unless noted. Ambient temperature = +25°Celsius, V_{IN} is nominal, output current is maximum rated nominal. External output capacitance is 1 μF multilayer ceramic paralleled with 10 μF electrolytic. All caps are low ESR. These capacitors are necessary for our test equipment and may not be needed in your application. Testing must be kept short enough that the converter does not appreciably heat up during testing. For extended testing, use plenty of airflow. See Derating Curves for temperature performance. All models are stable and regulate within spec without external cacacitance.
- ② Input Ripple Current is tested and specified over a 5-20 MHz bandwidth and uses a special set of external filters only for the Ripple Current specifications. Input filtering is C_{IN} = 33 µF, C_{BUS} = 220 µF, L_{BUS} = 12 µH. Use capacitor rated voltages which are twice the maximum expected voltage. Capacitors must accept high speed AC switching currents.
- ③ Note that Maximum Current Derating Curves indicate an average current at nominal input voltage. At higher temperatures and/or lower airflow, the converter will tolerate brief full current outputs if the average RMS current over time does not exceed the Derating curve. All Derating curves are presented at sea level altitude. Be aware of reduced power dissipation with increasing density altitude.
- ④ Mean Time Before Failure (MTBF) is calculated using the Telcordia (Belcore) SR-332 Method 1, Case 3, Issue 1, ground fixed conditions. Operating temperature = +30°C, full output load, natural air convection.
- The output may be shorted to ground indefinitely with no damage. The Output Short Circuit Current shown in the specifications is an average consisting of very short bursts of full rated current to test whether the output circuit can be repowered.
- The On/Off Control is normally driven from a switch or relay. An open collector/open drain transistor may be used in saturation and cut-off (pinch-off) modes. External logic may also be used if voltage levels are fully compliant to the specifications.
- Regulation specifications describe the deviation as the input line voltage or output load current is varied from a nominal midpoint value to either extreme (50% load).

- In the second maximum power ratings, Sense limits or output overvoltage when adjusting output trim values.
- ③ At zero output current, Vout may contain components which slightly exceed the ripple and noise specifications.
- Output overload protection is non-latching. When the output overload is removed, the output will automatically recover.
- All models are fully operational and meet published specifications, including "cold start" at -40°C.
- In the converter will shut off if the input falls below the undervoltage threshold. It will not restart until the input exceeds the Input Start Up Voltage.
- Short circuit shutdown begins when the output voltage degrades approximately 2% from the selected setting.
- Output noise may be further reduced by installing an external filter. See the Application Notes. Use only as much output filtering as needed <u>and no</u> <u>more</u>. Larger caps (especially low-ESR ceramic types) may slow transient response or degrade dynamic performance. Thoroughly test your application with all components installed.
- To avoid damage or unplanned shutdown, do not sink appreciable reverse output current.
- $_{(6)}$ If reverse polarity is accidentally applied to the input, always connect an external fast blow input fuse in series with the +V_{IN} input.
- Although extremely unlikely, failure of the internal components of this product may expose external application circuits to dangerous voltages, currents, temperatures or power levels. Please thoroughly verify all applications before committing them to service. Be sure to include appropriately rated FUSES (see specifications and Application Notes) to reduce the risk of failure.
- If Sense is not wired to an external load, connect sense pins to their respective Vout pins. Do not leave sense unconnected.
- Image: All models use fixed switching frequencies.

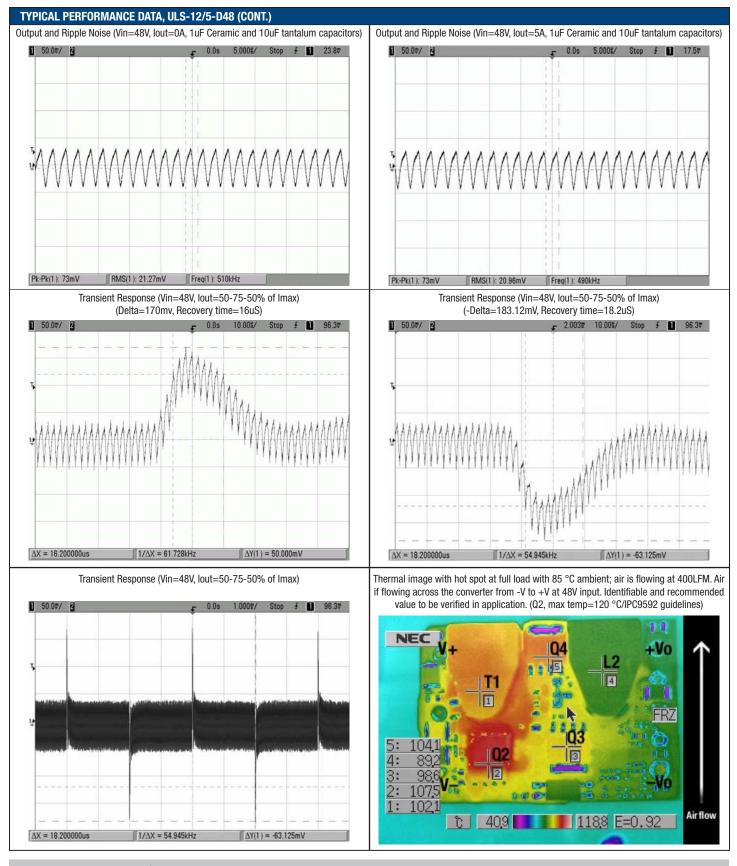
ULS 60-Watt Series

Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters



ULS 60-Watt Series

Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters

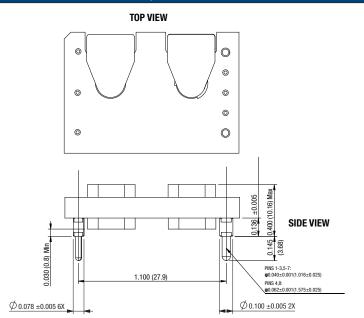




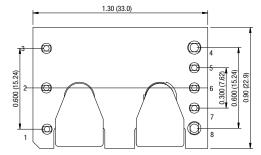
ULS 60-Watt Series

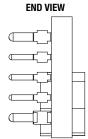
Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters

MECHANICAL SPECIFICATIONS, THROUGH-HOLE MOUNT

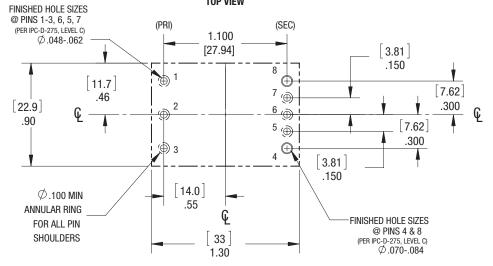


BOTTOM PIN VIEW





RECOMMENDED FOOTPRINT (VIEW THROUGH CONVERTER) TOP VIEW



	INPUT/OUTPUT CONNECTIONS P75					
Pin	Function	Pin	Function			
3	-Vin	4	-Vout			
		5	–Sense In			
2	On/Off Control	6	Trim			
		7	+Sense In			
1	+Vin	8	+Vout			

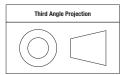
Important! <u>Always</u> connect the sense pins. If they are not connected to a remote load, wire each sense pin to its respective voltage output at the converter pins.

The 0.145-inch pin length is shown. Please refer to the part number structure for alternate pin lengths. Pin material: Copper alloy. Plating: Gold over nickel

Please note that some competitive units may use different pin numbering or alternate outline views; however, all units are plugin-compatible.

It is recommended that no parts be placed beneath the converter

Dimensions are in inches (mm) shown for ref. only.



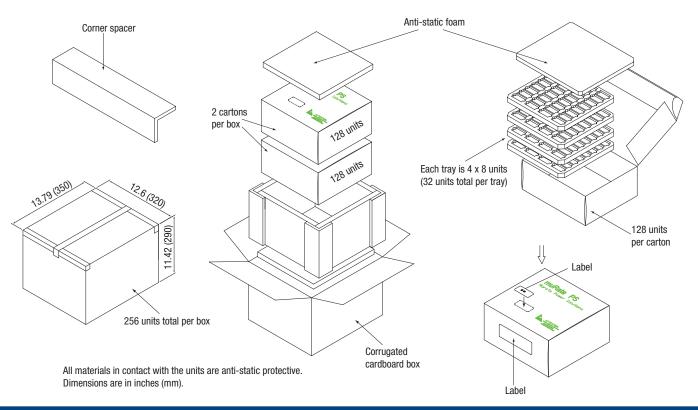
Tolerances (unless otherwise specified): .XX \pm 0.02 (0.5) .XXX \pm 0.010 (0.25) Angles \pm 2°

Components are shown for reference only and may vary between units.

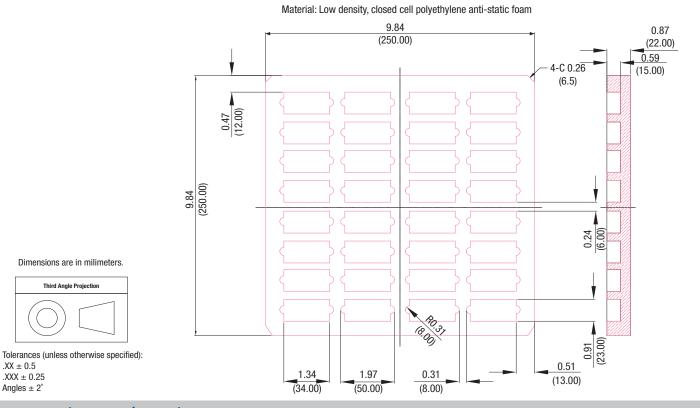
ULS 60-Watt Series

Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters

SHIPPING TRAYS AND BOXES, THROUGH-HOLE MOUNT



SHIPPING TRAY DIMENSIONS



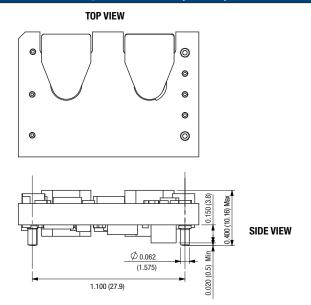
www.murata-ps.com/support



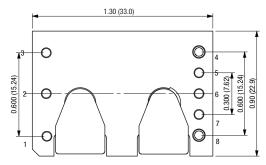
ULS 60-Watt Series

Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters

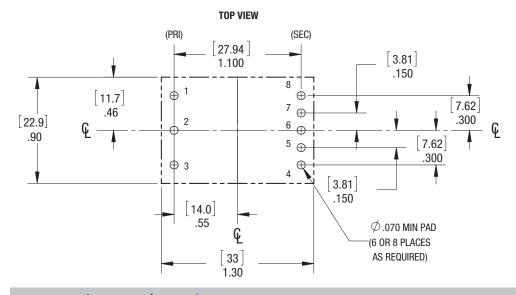
MECHANICAL SPECIFICATIONS, SURFACE MOUNT (MSL = 3)



BOTTOM PIN VIEW



RECOMMENDED FOOTPRINT (VIEW THROUGH CONVERTER)



	INPUT/OUTPUT CONNECTIONS P75					
Pin	Function	Pin	Function			
3	-Vin	4	-Vout			
		5	–Sense In			
2	On/Off Control	6	Trim			
		7	+Sense In			
1	+Vin	8	+Vout			

Important! <u>Always</u> connect the sense pins. If they are not connected to a remote load, wire each sense pin to its respective voltage output at the converter pins.

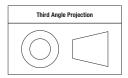
Pin material: Copper alloy. Plating: Gold over nickel

Please note that some competitive units may use different pin numbering or alternate outline views; however, all units are plugin-compatible.

It is recommended that no parts be placed beneath the converter

Dimensions are in inches (mm) shown for ref. only.

END VIEW



Tolerances (unless otherwise specified): .XX \pm 0.02 (0.5) .XXX \pm 0.010 (0.25) Angles \pm 2°

Components are shown for reference only and may vary between units.

TAPE AND REEL INFORMATION

ULS 60-Watt Series

Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters

FEED (UNWIND) DIRECTION CHAMFER ON PCB AND IN POCKET TO ASSURE PROPER ORIENTATION -[Ø1.50] 0.059 'ROUND' SPROCKET PIN #1 TYP (ORIENTATION)-HOLES [1.75] 0.069 [4.1] -0.16 00000 0 [22.0] 0.87 19 - P [40.40]1.591 [29.4] 1.16 SPROCKET [44.0] 1.73 G CENTERS REF 00 000000000 [32.0] [Ø9.00 MAX] 'OBLONG' 1.26 Ø0.354 MAX -SPROCKET PITCH É HOLES PICK-UP NOZZLE (REF) 282.3"+/-0.02" [7170mm+/-0.5mm] MIN LENGTH REQUIRED (224 MIN POCKETS) TO TAPE & REEL PRODUCT COVER TAPE-[24.44] [26.00] 1.023 0.962 REF REF [330.20] Ø13.00 je u TAPE AND REEL (200 UNITS PER REEL) 101.60 [13.00] Ø**4.00** Ø.512 [44.0] CORE 1.73 Dimensions are in inches (mm shown for ref. only). REF Third Angle Projection Tolerances (unless otherwise specified): .XX ± 0.02 (0.5) .XXX ± 0.010 (0.25) Angles ± 1° Components are shown for reference only.

ULS 60-Watt Series

Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters

TECHNICAL NOTES

Input Fusing

Certain applications and/or safety agencies may require the installation of fuses at the inputs of power conversion components. Fuses should also be used if the possibility of sustained, non-current-limited, input-voltage polarity reversals exists. For DATEL ULS series DC/DC converters, we recommend the use of a fast blow fuse, installed in the ungrounded input supply line with a typical value about twice the maximum input current, calculated at low line with the converter's minimum efficiency.

All relevant national and international safety standards and regulations must be observed by the installer. For system safety agency approvals, the converters must be installed in compliance with the requirements of the end- use safety standard.

Input Reverse-Polarity Protection

If the input voltage polarity is accidentally reversed, an internal diode will become forward biased and likely draw excessive current from the power source. If this source is not current limited or the circuit appropriately fused, it could cause permanent damage to the converter.

Pre-Bias Protection

For applications where a pre-bias potential can be present at the output of the power module it is recommended that either blocking diodes are added in series with the Vout power lines or, a preferred solution is to use an OR-ing FET controller like the LM5050-1 High-Side & LM5051 Low-Side OR-ing FET Controller from TI. Starting the module into a pre-bias condition can cause permanent damage to the module.

Input Under-Voltage Shutdown and Start-Up Threshold

Under normal start-up conditions, devices will not begin to regulate properly until the ramping-up input voltage exceeds the Start-Up Threshold Voltage. Once operating, devices will not turn off until the input voltage drops below the Under-Voltage Shutdown limit. Subsequent re-start will not occur until the input is brought back up to the Start-Up Threshold. This built in hysteresis prevents any unstable on/off situations from occurring at a single input voltage.

Start-Up Time

The V_{IN} to V_{OUT} Start-Up Time is the time interval between the point at which the ramping input voltage crosses the Start-Up Threshold and the fully loaded output voltage enters and remains within its specified accuracy band. Actual measured times will vary with input source impedance, external input capacitance, and the slew rate and final value of the input voltage as it appears at the converter. The ULS Series implements a soft start circuit to limit the duty cycle of its PWM controller at power up, thereby limiting the input inrush current.

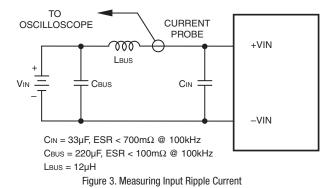
The On/Off Control to Vout start-up time assumes the converter has its nominal input voltage applied but is turned off via the On/Off Control pin. The specification defines the interval between the point at which the converter is turned on (released) and the fully loaded output voltage enters and remains within its specified accuracy band. Similar to the V_{IN} to Vout start-up, the On/Off Control to Vout start-up time is also governed by the internal soft start circuitry and external load capacitance. The difference in start up time from V_{IN} to Vout and from On/Off Control to Vout is therefore insignificant.

Input Source Impedance

The input of ULS converters must be driven from a low ac-impedance source. The DC/DC's performance and stability can be compromised by the use of highly inductive source impedances. The input circuit shown in Figure 3 is a practical solution that can be used to minimize the effects of inductance in the input traces. For optimum performance, components should be mounted close to the DC/DC converter.

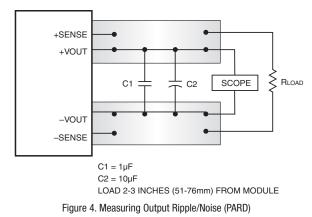
I/O Filtering, Input Ripple Current, and Output Noise

All models in the ULS Series are tested/specified for input reflected ripple current and output noise using the specified external input/output components/ circuits and layout as shown in the following two figures. External input capacitors (C_{IN} in Figure 3) serve primarily as energy-storage elements, minimizing line voltage variations caused by transient IR drops in conductors from backplane to the DC/DC. Input caps should be selected for bulk capacitance (at appropriate frequencies), low ESR, and high rms-ripple-current ratings. The switching nature of DC/DC converters requires that dc voltage sources have low ac impedance as highly inductive source impedance can affect system stability. In Figure 3, CBUS and LBUS simulate a typical dc voltage bus. Your specific system configuration may necessitate additional considerations.



In critical applications, output ripple/noise (also referred to as periodic and random deviations or PARD) may be reduced below specified limits using filtering techniques, the simplest of which is the installation of additional external output capacitors. They function as true filter elements and should be selected for bulk capacitance, low ESR and appropriate frequency response.

All external capacitors should have appropriate voltage ratings and be located as close to the converter as possible. Temperature variations for all relevant parameters should also be taken carefully into consideration. The most effective combination of external I/O capacitors will be a function of line voltage and source impedance, as well as particular load and layout conditions.



ULS 60-Watt Series

Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters

Floating Outputs

Since these are isolated DC/DC converters, their outputs are "floating" with respect to their input. Designers will normally use the –Output as the ground/ return of the load circuit. You can however, use the +Output as ground/return to effectively reverse the output polarity.

Minimum Output Loading Requirements

ULS converters employ a synchronous-rectifier design topology and all models regulate within spec and are stable under no-load to full load conditions. Operation under no-load conditions however might slightly increase the output ripple and noise.

Thermal Shutdown

The ULS converters are equipped with thermal-shutdown circuitry. If environmental conditions cause the temperature of the DC/DC converter to rise above the designed operating temperature, a precision temperature sensor will power down the unit. When the internal temperature decreases below the threshold of the temperature sensor, the unit will self start. See Performance/Functional Specifications.

Output Over-Voltage Protection

The ULS output voltage is monitored for an over-voltage condition using a comparator. The signal is optically coupled to the primary side and if the output voltage rises to a level which could be damaging to the load, the sensing circuitry will power down the PWM controller causing the output voltage to decrease. Following a time-out period the PWM will restart, causing the output voltage to ramp to its appropriate value. If the fault condition persists, and the output voltage again climbs to excessive levels, the over-voltage circuitry will initiate another shutdown cycle. This on/off cycling is referred to as "hiccup" mode.

Current Limiting

As soon as the output current increases to approximately 130% of its rated value, the DC/DC converter will go into a current-limiting mode. In this condition, the output voltage will decrease proportionately with increases in output current, thereby maintaining somewhat constant power dissipation. This is commonly referred to as power limiting. Current limit inception is defined as the point at which the full-power output voltage falls below the specified tolerance. See Performance/Functional Specifications. If the load current, being drawn from the converter, is significant enough, the unit will go into a short circuit condition as described below.

Short Circuit Condition

When a converter is in current-limit mode, the output voltage will drop as the output current demand increases. If the output voltage drops too low, the magnetically coupled voltage used to develop primary side voltages will also drop, thereby shutting down the PWM controller. Following a time-out period, the PWM will restart causing the output voltage to begin ramping to their appropriate value. If the short-circuit condition persists, another shutdown cycle will be initiated. This on/off cycling is referred to as "hiccup" mode. The hiccup cycling reduces the average output current, thereby preventing internal temperatures from rising to excessive levels. The ULS Series is capable of enduring an indefinite short circuit output condition.

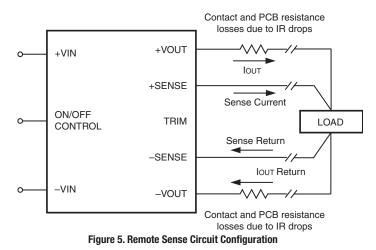
Remote Sense

Note: The Sense and V_{OUT} lines are internally connected through low-value resistors. Nevertheless, if the sense function is not used for remote regulation the user should connect the +Sense to +V_{OUT} and –Sense to –V_{OUT} at the DC/DC converter pins. ULS series converters employ a sense feature to provide point of use regulation, thereby overcoming moderate IR drops in PCB conductors or cabling. The remote sense lines carry very little current and therefore require minimal cross-sectional-area conductors. The sense lines, which are capacitively coupled to their respective output lines, are used by the feedback control-loop to regulate the output. As such, they are not low impedance points and must be treated with care in layouts and cabling. Sense lines on a PCB should be run adjacent to dc signals, preferably ground.

 $[VOUT(+)-VOUT(-)] - [Sense(+)-Sense(-)] \le 10\% VOUT$

In cables and discrete wiring applications, twisted pair or other techniques should be used. Output over-voltage protection is monitored at the output voltage pin, not the Sense pin. Therefore, excessive voltage differences between V_{0UT} and Sense in conjunction with trim adjustment of the output voltage can cause the over-voltage protection circuitry to activate (see Performance Specifications for over-voltage limits). Power derating is based on maximum output current and voltage at the converter's output pins. Use of trim and sense functions can cause output voltages to increase, thereby increasing output power beyond the converter's specified rating, or cause output voltages to climb into the output over-voltage region. Therefore, the designer must ensure:

(Vour at pins) x (lour) \leq rated output power



On/Off Control

The input-side, remote On/Off Control function can be ordered to operate with either logic type:

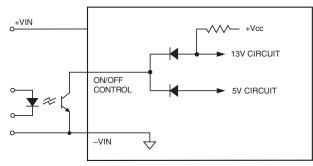
Positive ("P" suffix) logic models are enabled when the on/off pin is left open (or is pulled high, applying +3.5V to +15V with respect to -Input) as per Figure 6. Positive-logic devices are disabled when the on/off pin is pulled low (0 to 1V with respect to -Input).

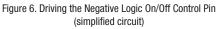
Negative ("N" suffix) logic devices are off when pin is left open (or pulled high, applying +2.5V to +15V), and on when pin is pulled low (-0.1 to +0.8V) with respect to -Input as shown in Figure 6.

ULS 60-Watt Series

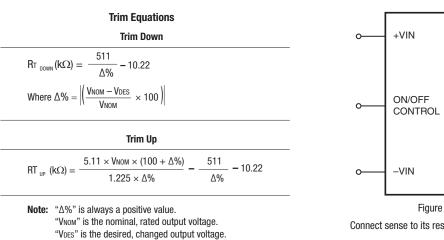
Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters

Dynamic control of the remote on/off function is best accomplished with a mechanical relay or an open-collector/open-drain drive circuit (optically isolated if appropriate). The drive circuit should be able to sink appropriate current (see Performance Specifications) when activated and withstand appropriate voltage when deactivated. Applying an external voltage to pin 2 when no input power is applied to the converter can cause permanent damage to the converter.





OUTPUT VOLTAGE ADJUSTMENT



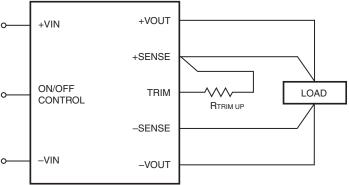


Figure 7. Trim Connections To Increase Output Voltages Connect sense to its respective Vour pin if sense is not used with a remote load.

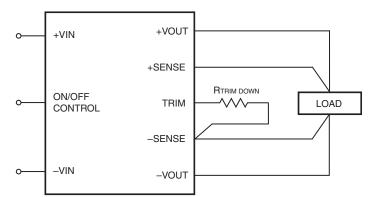


Figure 8. Trim Connections To Decrease Output Voltages

ULS 60-Watt Series

Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters

Trimming by Using an External Voltage Source

1. The easiest way to trim the output using an external voltage source is to drive the Trim pin directly from a variable source. The following equation can be used to calculate the voltage at the Trim pin.

Vo is the output voltage you want; Vonominal is the nominal output voltage;

$$Vtrim = 2 \times 1.225 \times \frac{Vo}{Vonominal} - 1.225$$

Vtrim is the voltage that should appear at the trim pin.

2. If the purpose of trimming is to compensate voltage drop of power path from converter to the Load, you may separately connect the sense pin directly to the load. It's much easier than real time adjusting trim voltage.

3. CAUTION: To avoid unplanned power down cycles, do not exceed EITHER the maximum output voltage OR the maximum output power when setting the trim. If the output voltage is excessive, the OVP circuit may shut down the converter. If the maximum power is exceeded, the converter may enter current limiting. If the power is exceeded for an extended period, the converter may overheat and encounter overtemperature shut down. Be careful of external electrical noise. The Trim input is a sensitive input to the converter's feedback control loop. Excessive electrical noise may cause instability or oscillation.

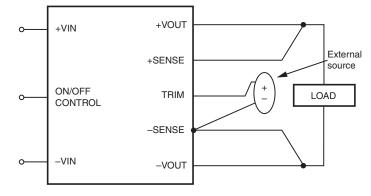


Figure 9. Trimming with an External Source

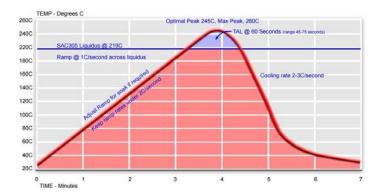
Through-hole Soldering Guidelines

Murata Power Solutions recommends the TH soldering specifications below when installing these converters. These specifications vary depending on the solder type. Exceeding these specifications may cause damage to the product. Your production environment may differ; therefore please thoroughly review these guidelines with your process engineers.

Wave Solder Operations for through-hole mounted products (THMT)				
For Sn/Ag/Cu based solders:				
Maximum Preheat Temperature	115° C.			
Maximum Pot Temperature	270° C.			
Maximum Solder Dwell Time	7 seconds			
For Sn/Pb based solders:				
Maximum Preheat Temperature	105° C.			
Maximum Pot Temperature	250° C.			
Maximum Solder Dwell Time	6 seconds			

SMT Reflow Soldering Guidelines

The surface-mount reflow solder profile shown below is suitable for SAC305 type leadfree solders. This graph should be used only as a *guideline*. Many other factors influence the success of SMT reflow soldering. Since your production environment may differ, please thoroughly review these guidelines with your process engineers.



ULS 60-Watt Series

Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters

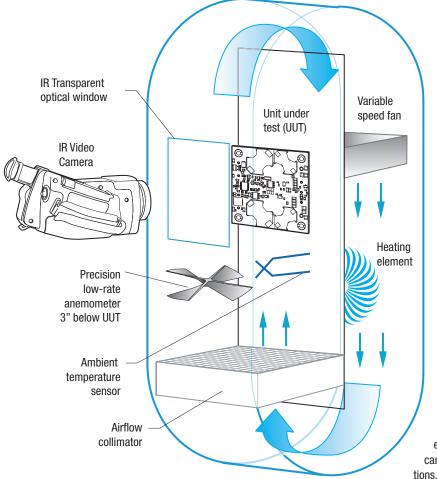


Figure 10. Vertical Wind Tunnel

Vertical Wind Tunnel

Murata Power Solutions employs a computer controlled custom-designed closed loop vertical wind tunnel, infrared video camera system, and test instrumentation for accurate airflow and heat dissipation analysis of power products. The system includes a precision low flow-rate anemometer, variable speed fan, power supply input and load controls, temperature gauges, and adjustable heating element.

The IR camera monitors the thermal performance of the Unit Under Test (UUT) under static steady-state conditions. A special optical port is used which is transparent to infrared wavelengths.

Both through-hole and surface mount converters are soldered down to a host carrier board for realistic heat absorption and spreading. Both longitudinal and transverse airflow studies are possible by rotation of this carrier board since there are often significant differences in the heat dissipation in the two airflow directions. The combination of adjustable airflow, adjustable ambient heat, and adjustable Input/Output currents and voltages mean that a very wide range of measurement conditions can be studied.

The collimator reduces the amount of turbulence adjacent to the UUT by minimizing airflow turbulence. Such turbulence influences the effective heat transfer characteristics and gives false readings. Excess turbulence removes more heat from some surfaces and less heat from others, possibly causing uneven overheating.

Both sides of the UUT are studied since there are different thermal gradients on each side. The adjustable heating element and fan, built-in temperature gauges, and no-contact IR camera mean that power supplies are tested in real-world condions.

<u>muRata</u> **P**_ Murata Power **Sol**utions

ULS 60-Watt Series

Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters

Product Model Specific Availability:

MPS Part Number	Product Status	LTB Date
ULS-12/5-D48N-C	In Production	N/A
ULS-12/5-D48NH-C	Discontinued	3/31/2022
ULS-12/5-D48NH-Y	Discontinued	3/31/2022
ULS-12/5-D48NL1-C	In Production	N/A
ULS-12/5-D48NL2-C	Discontinued	3/31/2022
ULS-12/5-D48NM-C	Discontinued	3/31/2022
ULS-12/5-D48N-Y	Discontinued	3/31/2022
ULS-12/5-D48P-C	Discontinued	3/31/2022
ULS-12/5-D48PH-C	Discontinued	3/31/2022
ULS-12/5-D48PH-Y	Discontinued	3/31/2022
ULS-12/5-D48PL2-C	Discontinued	3/31/2022
ULS-12/5-D48PM-C	Discontinued	3/31/2022
ULS-12/5-D48P-Y	Discontinued	3/31/2022
ULS-3.3/20-D48N-C	Discontinued	3/31/2022
ULS-3.3/20-D48NH-C	Discontinued	3/31/2022
ULS-3.3/20-D48NH-Y	Discontinued	3/31/2022
ULS-3.3/20-D48NL2-C	Discontinued	3/31/2022
ULS-3.3/20-D48NL2-Y	Discontinued	3/31/2022
ULS-3.3/20-D48NM-C	Discontinued	3/31/2022
ULS-3.3/20-D48N-Y	Discontinued	3/31/2022
ULS-3.3/20-D48PB-C	Discontinued	3/31/2022
ULS-3.3/20-D48P-C	Discontinued	3/31/2022
ULS-3.3/20-D48PH-C	Discontinued	3/31/2022
ULS-3.3/20-D48PH-Y	Discontinued	3/31/2022
ULS-3.3/20-D48PM-C	Discontinued	3/31/2022
ULS-3.3/20-D48P-Y	Discontinued	3/31/2022
ULS-5/12-D48N-C	Discontinued	3/31/2022
ULS-5/12-D48NH-C	Discontinued	3/31/2022
ULS-5/12-D48NH-Y	Discontinued	3/31/2022
ULS-5/12-D48NL1-C	Discontinued	3/31/2022
ULS-5/12-D48NM-C	Discontinued	3/31/2022
ULS-5/12-D48N-Y	Discontinued	3/31/2022
ULS-5/12-D48P-C	Discontinued	3/31/2022
ULS-5/12-D48PH-C	Discontinued	3/31/2022
ULS-5/12-D48PH-Y	Discontinued	3/31/2022
ULS-5/12-D48PL2-C	Discontinued	3/31/2022
ULS-5/12-D48PM-C	Discontinued	3/31/2022
ULS-5/12-D48P-Y	Discontinued	3/31/2022

Under	Products under development. Listed product specifications are subject to change without
Under Development	prior notice. Please contact us for sample availability and mass production schedule.
In Production	Product is in mass production.
NRND	Not recommended for new design.
To be discontinued	We are planning to discontinue production of this item. 'Last Time Buy' date or Discontinuation date may be shown on our web site. Before these dates, please contact us with your requirements
Discontinued	Production of this product has stopped.
Recommended	Murata particularly recommends this product for reasons of size and performance. Please contact Murata regarding pricing and delivery.
New	This is a new product. Please contact Murata regarding pricing and delivery.

Link back to part number configuration

Murata Power Solutions, Inc. 129 Flanders Road, Westborough, MA 01581 U.S.A. ISO 9001 REGISTERED



This product is subject to the following operating requirements and the Life and Safety Critical Application Sales Policy: Refer to: https://www.murata-ps.com/requirements/

Murata Power Solutions, inc. makes no representation that the use of its products in the circuits described herein, or the use of other technical information contained herein, will not infringe upon existing or future patent rights. The descriptions contained herein do not imply the granting of licenses to make, use, or sell equipment constructed in accordance therewith. Specifications are subject to change without notice. ©2023 Murata Power Solutions, Inc.